A2 COMPUTER SCIENCE
AS Revision Sept 11 2025

H046 – Computing Principles, Algorithms and Programming

Name: Block

Mark: /90 Percentage:

Grade:

Note: Calculators are not allowed.
Duration of exam: 90 minutes
Answer all questions.

Answer **all** the questions.

1 Arnold has several computing devices around his home. Each device has an operating system installed.

(a) Arnold has a PC which has a Basic Input Output System (BIOS).

Describe what is meant by the term 'BIOS'.

[2]

(b) Arnold has a router. It will receive data packets from other computers on Arnold's network or the internet and then route them on to the next step.

The scheduling algorithm Arnold's router uses is First Come First Served.

(i) State the name of **one** other scheduling algorithm.

.....

..... **[1]**

(ii) Explain why First Come First Served is a suitable scheduling algorithm for Arnold's router.

.....

.....

.....

[2]

(c) One role of an operating system is to manage the computer's memory.

Two types of memory management are paging and segmentation.

Describe **one** difference between paging and segmentation.

[2]

(d) Different computing devices in Arnold's home use different processor architectures.

One processor architecture is the Harvard architecture.

(i) Describe the Harvard architecture.

[2]

(ii) Arnold has a smart washing machine.

Explain why the Harvard architecture is suitable for a device like this.

[2]

(e) Another role of an operating system is the Interrupt Service Handler. This allows processes being executed by the CPU to be interrupted.

(i) One example of an interrupt would be removing an external hard disk drive from a computer.

State why this would need to interrupt the current fetch-decode-execute cycle of the CPU.

[1]

(ii) Interrupt Service Handlers make use of a stack data structure.

Describe how a stack is used when handling interrupts.

[2]

2 Charlie owns a veterinary surgery in her local town. She has purchased a new computer for her business so she can complete her accounts, write letters to her customers and keep a record of her customers' personal and appointment details.

She intends to install application software and utility software.

(a) Charlie will install database application software on her computer.

State **one** additional type of application software Charlie could install and give an example of what she might use it for.

[2]

(b) Charlie's computer has firewall utility software already installed.

Explain **two** other pieces of utility software that Charlie should install on her computer.

1

2

[4]

(c)* Charlie will use database management software to store customers' personal and appointment details. Charlie is considering both open source and closed source database software.

Compare the differences between open source software and closed source software and recommend which type of database software Charlie should use.

You should refer to the following in your answer:

- Cost
- Usability
- Extensibility
- Security
- Support available

3 **(a) State why computer systems store data in binary.**

[1]

(b) (i) Convert the denary number 97 into an 8-bit binary number.

[1]

(ii) Convert the denary number 171 into a hexadecimal number.

[1]

(iii) Convert the denary number –97 into an 8-bit binary number using two's complement.

[1]

(iv) Convert the denary number –17 into an 8-bit binary number using sign and magnitude.

[1]

(c) State **one** advantage of using two's complement instead of sign and magnitude.

[2]

(d) Calculate the addition of these two 8-bit (unsigned) binary numbers.

Show your working.

11011011
10001001 +

[2]

4 Elliott has designed a logic circuit. The expression he has created for the logic circuit is:

$Q = (A \wedge \neg B) \vee (\neg A \wedge C \wedge D) \vee (A \wedge B)$

(a) Complete the Karnaugh Map below to simplify this expression. Show your working.

CD \ AB	00	01	11	10
00				
01				
11				
10				

Simplified expression:

[4]

5 Kylie buys used games consoles and then sells them to make a profit. She sells her products in multiples of £5 such as £30, £55 and £95. Kylie only accepts £50, £20, £10 and £5 notes from her customers.

Kylie has written an algorithm which will calculate the amount of change needed by stating how many £20, £10 and £5 notes are needed.

The program should output the minimum number of notes required. For example if £35 change is required then it should output 1 x £20 and 1 x £10 and 1 x £5.

```
01 total = input("Enter total price of goods")
02 paid = input("Enter amount paid")
03 global change = paid - total
04 calculateChange()
05
06 procedure calculateChange()
07      twenty = 0
08      ten = 0
09      five = 0
10      while change >= 20 //Calculates number of £20 notes needed
11          twenty = twenty + 1
12          change = change - 20
13      endwhile
14      while change >= 10 //Calculates number of £10 notes needed
15          ten = ten + 1
16          change = change - 10
17      endwhile
18      while change >= 5 //Calculates number of £5 notes needed
19          five = five + 1
20          change = change - 5
21      endwhile
22      print("The amount of change you need is £" + str(change))
23      print("Total £20 Notes:" + str(twenty))
24      print("Total £10 Notes:" + str(ten))
25      print("Total £5 Notes:" + str(five))
26 endprocedure
```

(a) Describe how `calculateChange()` on line 04 is used differently to `calculateChange()` on line 06.

[2]

(b) When line 22 is run, it will always print:

```
The amount of change you need is £0
```

Explain why this error occurs when line 22 is run.

[2]

(c) Explain why Kylie has used `str` on lines 22 to 25 in her algorithm.

[3]

END OF Part A

1 A program uses a bubble sort to sort data into ascending numerical order.

The data is stored in a 0-indexed 1-dimensional array.

(a) Show each stage of a bubble sort to sort this data into ascending numerical order:

1	5	3	9	2	7

You should clearly show and label each pass in your answer.

[4]

(b) A programmer has partially developed a bubble sort algorithm in pseudocode.

This will partially sort an array of numbers called `numbers` that is passed as a parameter.

```
01 procedure bubbleSort(numbers : byRef)
02    flag = true
03    for x = 0 to numbers.length - 1
04      if numbers[x] > numbers[x + 1] then
05        holdValue = numbers[x]
06        numbers[x] = numbers[x + 1]
07        numbers[x + 1] = holdValue
08        flag = false
09      endif
10    next x
11 endprocedure
```

(i) Explain why the procedure `bubbleSort` accepts the array `numbers` by reference and not by value.

[3]

(ii) The programmer has used a `for` loop on line 3 in the procedure `bubbleSort`. A `for` loop is a count controlled loop.

State what is meant by the term 'count controlled loop'.

[1]

(iii) **State the purpose of the variable `holdValue` in the procedure `bubbleSort`.**

[3]

(iv) **The procedure `bubbleSort` will only partially sort the array `numbers` into order.**

Describe what the programmer would need to add to the algorithm to enable it to fully sort the numbers into order.

[2]

(c) **(i)** **The array `numbers` contains 356 numbers to be sorted by the bubble sort algorithm.**

State the maximum number of passes a bubble sort would need to complete to sort 356 numbers into order.

[1]

(ii) State the name of **one** other sorting algorithm.

[1]

2 Taylor is designing a program for a client who would like to simulate earthquakes on major cities around the world in 3D. The client would like to be able to view any stage of an earthquake such as:

1. the build-up of the earthquake
2. the earthquake taking place
3. the aftershocks of the earthquake.

The client would also like to be able to play the simulation at different speeds. For example, a slow, normal or fast speed.

(a) Give **three** examples of where abstraction can be used in the design of this program.

1

2

3

[3]

(b) The program will need to accept inputs from the user before playing the simulation.

(i) Identify **two** different inputs for this program.

1

2

[2]

(ii) One decision point in the program will be to decide if the user inputs are suitable or not.

Identify **two** other example decision points in this program.

1

2

[2]

3* Nina is writing a computer game using an Integrated Development Environment (IDE). Her friend, James, is writing a computer game using a text-editor which will allow James to create and edit text. James will use a separate compiler.

Discuss the differences between writing and debugging a program using an IDE and a text-editor.

You should include the following in your answer:

- features that are used when writing code
- features that are used when debugging code
- the benefits of using an IDE instead of a text-editor.

9

[9]

4 Layla writes a pseudocode algorithm to:

- input 20 positive numbers into a 0-indexed 1-dimensional array
- output the average (mean) number as a decimal
- output the smallest number
- output the largest number.

The pseudocode algorithm is shown. It contains various errors.

```
01 total = 1
02 smallest = 9999
03 largest = -1
04 for x = 0 to 21
05   dataArray[x] = input("Enter a number")
06   total = total + dataArray[x]
07   if dataArray[x] < largest then
08     largest = dataArray[x]
09   endif
10   if dataArray[x] < smallest then
11     smallest = dataArray[x]
12   endif
13 next x
14 print("Average = " + total * 20)
15 print("Smallest = " + smallest)
16 print("Largest = " + largest)
```

(a) (i) Identify the construct used on lines 01 to 03 in the algorithm.

[1]

(ii) Identify the construct used on lines 10 to 12 in the algorithm.

[1]

(b) Identify **two** variables used in this algorithm.

1

2

[2]

(c) The algorithm that Layla has written has many errors.

Identify the line number of **four** different errors and write the corrected line of code.

Error 1 line number .....

Error 1 correction

Error 2 line number .....

Error 2 correction

Error 3 line number .....

Error 3 correction

Error 4 line number .....

Error 4 correction

[4]

(d) `dataArray` is defined as a local variable within the main program.

(i) State what is meant by a 'local variable'.

[1]

(ii) Give **one** benefit and **one** drawback of declaring `dataArray` as a local variable in the main program.

Benefit

Drawback

[2]

END OF PAPER